

Fermilab's Role in the International Linear Collider

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The Fermilab Long Range Plan

Vision

- The Fermilab Director established the Fermilab Long Range Planning Committee (FLRPC) in the spring of 2003. This committee has completed its report and it is available at:
http://www.fnal.gov/directorate/Longrange/Long_range_planning.html
- The overarching vision is that Fermilab will remain the primary site for accelerator-based particle physics in the U.S. in the next decade and beyond.
 - As host to a linear collider Fermilab would be established as a world center for the physics of the energy frontier for decades.
 - If the linear collider is constructed elsewhere, or delayed, Fermilab would strive to become a world center of excellence in neutrino physics, based on a (SCLinac) multi-MW “Proton Driver”, still with significant LC participation.

Fermilab is pursuing linear collider and proton driver R&D in parallel.
A cold decision would facilitate close alignment of these paths.

The Fermilab Long Range Plan

Recommendations

- In support of these two visions the FLRPC report offers a series of recommendations:
 - Linear Collider recommendations aim at establishing leadership in two significant technical areas (e.g. linac, damping ring, and/or sources), playing a leading role in the major engineering systems test, and taking the steps necessary to allow Fermilab to make a strong bid to become LC host laboratory.
 - Foresees consolidation of resources following technology decision.
 - Proton Driver recommendations aim at establishing the physics case, and developing the SC linac technology to the point that a cost benefit analysis can be done and the linac/synchrotron technology selection made.
 - Leading to documentation sufficient to support CD-0 (establishment of mission need in the DOE system).

International Linear Collider (ILC)

Physical Scope

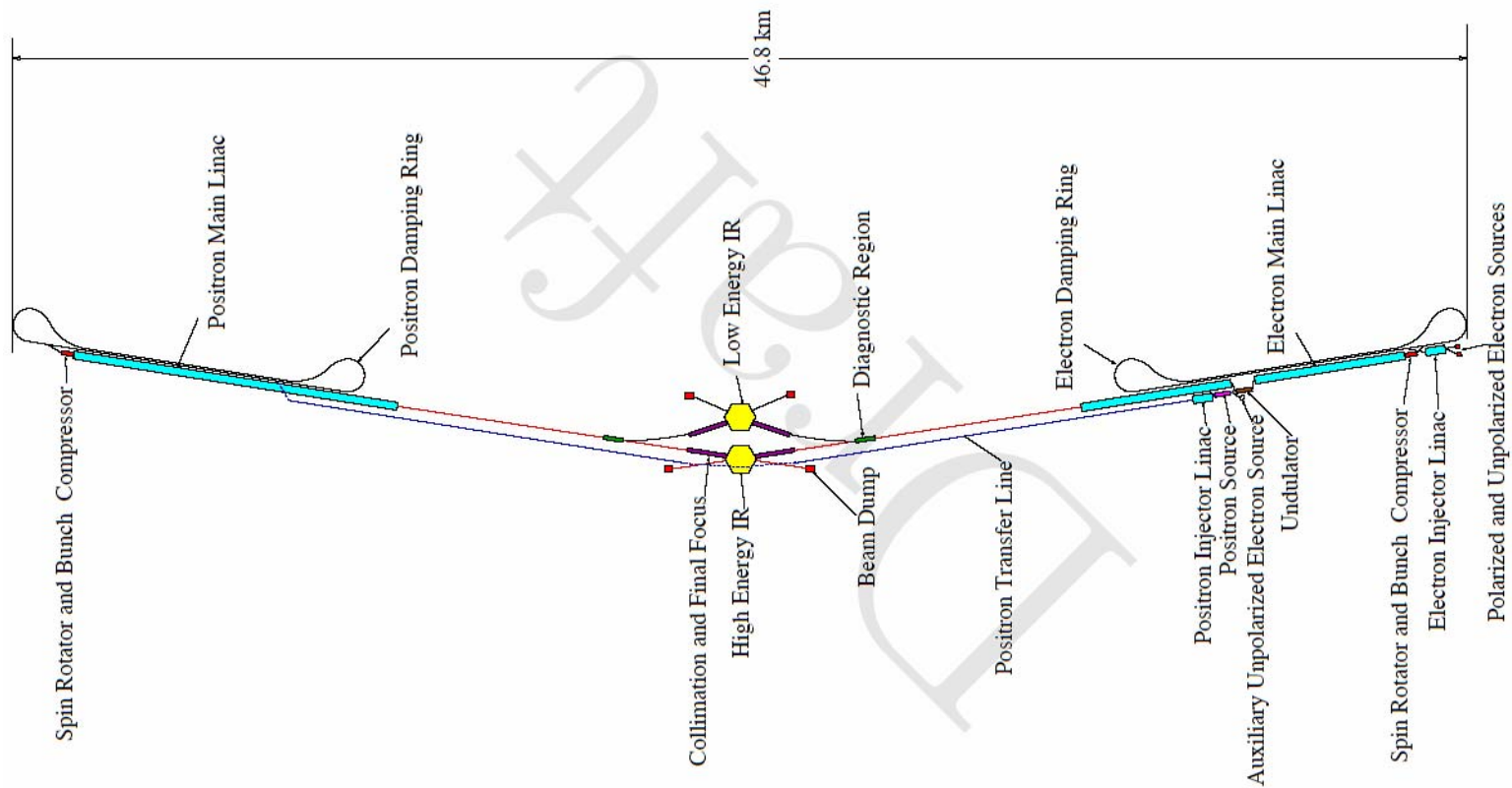


Figure 3.5.1.1: Overall Machine Layout, 500 GeV c.m.

Fermilab and the ILC

Background

- Fermilab has presented publicly its vision for the future as developed within the Fermilab Long Range Plan:
 - Host lab for an internationally constructed and operated Linear Collider;
 - Home to a world-leading neutrino program based on a “Proton Driver”
- Fermilab has submitted a bid to host the GDI/CT (July 1, 2004).
- Fermilab has publicly expressed a desire to bid for host laboratory.
- Fermilab has stated publicly “In the event of a cold decision Fermilab would be ready and able to assume the leadership role in establishing a U.S. collaboration to push the SCRF development under the aegis of an international LC organization.”

Following the cold technology decision Fermilab, with help from our neighboring institutions, is now preparing to follow through on that commitment

Fermilab and the ILC

The Next Steps

- The first imperative is establishment of US-based capability in the fabrication of high gradient superconducting accelerating structures.
 - Existing scrf expertise at: Fermilab, Jefferson Lab, Cornell, Argonne
- Establishment of the SMTF (Superconducting Module Test Facility).
 - Centerpiece of the US effort on high gradient SCRF
 - National collaboration of major DOE and NSF laboratories and universities.
 - EOI in preparation, goal is submission to Fermilab Director ~10/1
 - Will propose construction of SMTF at Fermilab (Meson Area)
- Bid to host
 - Siting and civil studies
 - Public outreach
 - Would benefit from an integrated northern Illinois effort

SMTF Collaboration

“The goal is to develop U.S. capabilities in high gradient superconducting accelerating structures in support of the International Linear Collider (ILC) and other accelerator projects of interest to U.S. laboratories.”

Participants

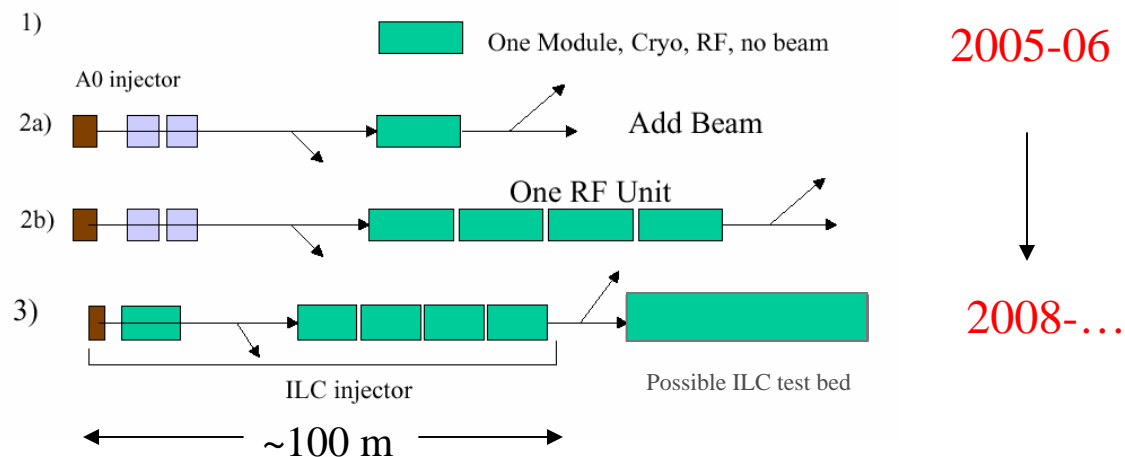
ANL	LBL
BNL	MIT
Cornell	MSU
Fermilab	NIU
Jefferson Lab	ORNL
LANL	SLAC

- First meeting at Argonne 2/23/04
 - Capabilities & interests of the labs
 - Forming a collaboration
 - Concept of SMTF
 - Facility for testing of SRF modules and related equipment
- Second meeting on 5/27,28
 - How to incorporate LC R&D into this program given a cold decision
- Third meeting on 9/30 at JLab
 - Finalization of the EOI

SMTF and the ILC

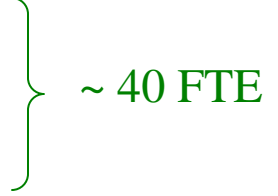
Phased Approach

- The next steps in cold ILC technology development:
 - Development of US capability in high gradient structures, as a prelude to industrialization
 - (High gradient means >35 MV/m)
- Phased evolution of the SMTF, in coordination with national and international partners



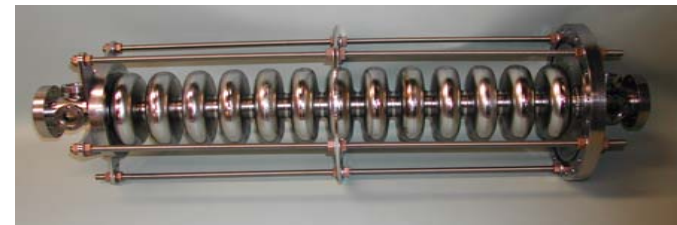
ILC Activities at Fermilab

Resources

- Total Fermilab effort is ~\$4M; static at this level since FY2001.
 - Represents 15-20% of U.S. linear collider effort.
 - ~\$3M in support of X-band
 - ~\$1M in support of SCRF
 - Another ~\$1M in support of SCRF not directly ILC related. ~ 40 FTE
- Consolidation of ILC effort along the SCRF direction is underway and will be in place for FY2005.
 - ⇒ ~\$5M effort in FY05 (Fermilab funds only)
- Total resources (not just Fermilab, but world-wide) are going to have to grow substantially to realize a ILC
- The FLRPC report advocates growth of Fermilab effort to ~\$20M/year at the time of construction of the major systems engineering test(s), and to ~\$100M/year at the time of the ILC construction start (~1/3 of the laboratory effort) in the Fermilab as host lab scenario.

ILC Activities at Fermilab

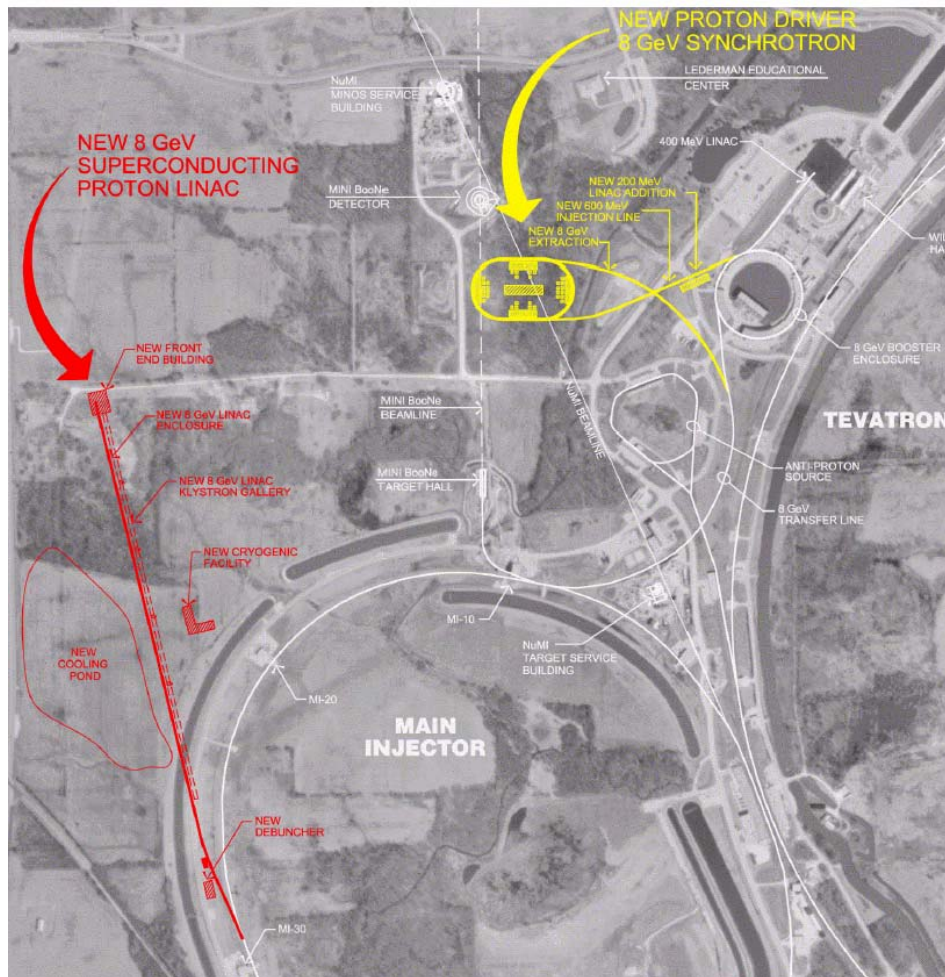
- NLC
 - X-band structures fabrication
 - 5 of the 8 structures at successful NLCTA test were built by Fermilab
 - Civil/siting studies
- SCRF
 - Operation of 15 MeV photoinjector (identical to TTF injector)
 - SCRF cavity development for FNPL and CKM (now defunct)
- Extremely talented scientific & engineering group in place with ability to work on warm or cold structures



⇒ Bottom line: By redirecting x-band and focusing SCRF more strongly on ILC Fermilab can effectively double resources in FY05.

Fermilab Proton Driver

(<http://www-bd.fnal.gov/pdriver/>)

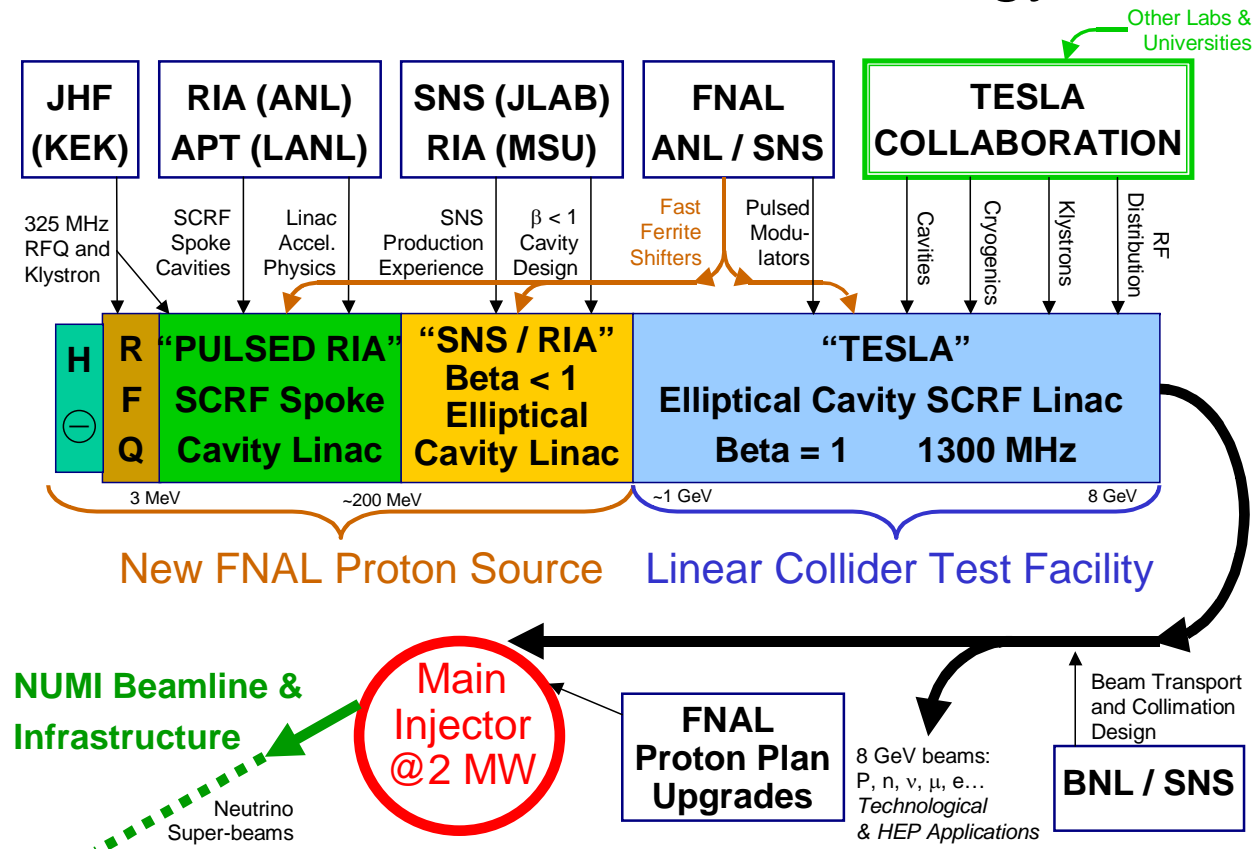


- Motivation: Neutrino "superbeams"
- The Fermilab Linac and Booster are incapable of meeting the projected demand for protons ~10 years from now.
- High level parameters:
 - 0.5-2.0 MW beam power at 8 GeV
 - 2.0 MW beam power at 120 GeV (6 × current Main Injector)
- Possible implementations:
 - 8 GeV synchrotron; or
 - 8 GeV superconducting linac
- The SC linac is preferred:
 - Better performance over entire energy range
 - Flexibility (possible e^- acceleration)

Fermilab Proton Driver

8 GeV SC Linac: Synergies

Proton Driver Linac - Technology Flow



International Linear Collider

Synergies with Proton Driver

- The decision to base the ILC on a superconducting linac affords Fermilab the opportunity of a more efficient approach to our two primary accelerator R&D programs.
 - The Proton Driver could be configured to allow a 1% systems test based on acceleration of electrons (on off cycles if necessary), as part of a GDI sponsored systems test program:
 - ILC compatible frequencies (1300 and 325 MHz)
 - Allows making use of considerable investment in industrialization of rf sources and accelerating structures.
 - Structure development and industrialization
 - 288 TESLA cavities in 36 cryomodules
 - Seed project for large scale industrial development (in U.S. and/or abroad)
 - While the ultimate goal is the Linear Collider, the Proton Driver would provide significant relevant experience while enabling a forefront physics program even in the event the Linear Collider were delayed.
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Summary

Implications of the Cold Decision at Fermilab

- The vision for Fermilab in the middle of the next decade:
 - Host lab for an internationally constructed and operated Linear Collider;
 - Home to a world-leading neutrino program
- The preferred outcome is an International Linear Collider
 - Publicly stated desire to host
- (Fermilab is committed to significant ILC participation independent of technology chosen.
 - Fermilab is contributing to both warm and cold efforts)
- Fermilab has significant experience with large superconducting and cryogenic systems and growing expertise in SCRF.
- In the event of a cold decision Fermilab would be ready and able to assume the leadership role in establishing a U.S. collaboration to push the SCRF development under the aegis of an international LC organization.

Summary

The Path Forward

- Fermilab is preparing to execute its responsibilities to carry through on the commitment in the last bullet.
 - Leadership on the SMTF
 - Should carry through to ~2008.
 - Needs to be done in coordination with the international ILC effort.
- Other activities will move forward in parallel
 - R&D on other selected accelerator subsystems
 - Bid to host activities
 - Host to the GDI/Central Team (perhaps)
- The cold technology decision is allowing us to integrate the two primary thrusts of our accelerator R&D program (ILC and PD)
- The construction of the ILC in northern Illinois, with Fermilab as host lab, would establish Fermilab as a center for elementary particle physics for decades to come.